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ACTIVE LIQUID SOLAR SYSTEM

Prepared for
MONTANA DEPARTMENT of NATURAL RESOURCES and CONSERVATION

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ACTIVE LIQUID SOLAR SYSTEM

Prepared by

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March, 1980

Prepared for

Montana Department of Natural Resources and Conservation
32 South Ewing, Helena, Montana 59620
Renewable Energy and Conservation Program
Grant Agreement Number 058-761

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DESCRIPTION OF PROJECT

The project for which this grant has been used is a combination demonstration and research model. The primary intention is to demonstrate the feasibility of utilization of solar energy in the Billings micro-climate. It is hoped this demonstration will help spur further development and utilization fo solar energy systems, not only in Billings, but in the rest of Montana.

As a research project, the system and its function will be monitored to compile data concerning performance of the specific system in relation to the Billings micro-climate. The data will then be used to make technical modifications to the system and to be available to apply to the design of similar or different solar systems. The entire project will be monitored as an on-going engineering/architectural study for immediate and future application for further development. Montana Power Company has been contacted to monitor the system for any use they may have for such data to compare conventional housing with a solar utilization system. As yet, they have not committed to any involvement.

Alternate Energy System - Solar Utilization

1. Basic System Description - The solar energy system for this project is a hydronic system of flat plate collectors through which a fluid is circulated and pumped to storage tanks from which stored heat is drawn when the living spaces call for warming. More specifically, the system is using a commercially available collector manufactured by Solarmatic and is described in the enclosed materials list.

A 50-50 solution of ethylene glycol and distilled water is circulated via a pump in a closed loop from the flat plate collectors through two heat storage tanks containing 1000 gallons of water each. A heat exchanger in the line of the closed doop transfers collected heat from the anti-freeze solution to the water. The closed loop is utilized for two purposes: (1) to minimize the amount of anti-freeze solution and, thus, reduces the cost of the heat transfer media, and (2) to prevent loss of the storage water should trouble occur with the heat gain loop or the collectors. A small holding tank will be provided should this loop have to be drained.

From the water storage tanks, warm water is pumped through a water-to-air heat exchanger located in the plenum of the duct system. The fan in the heat pump forces air across this exchanger and circulates it to the rooms. Dampers installed in the duct work facilitate proper air balance. The auxiliary heat system connected to the duct work is a heat pump manufactured by Carrier.

Domestic water heating will also be supplemented by heat collected from the bank of flat-plate collectors. A 25 gallon steel preheat tank is installed in one of the storage tanks. This function will operate year-round while the room conditioning system will only operate during the required periods of the year.

2. Description of Change-over Operation from Solar Utilization to Conventional Heating System (heat pump) - At a solar water storage temperature below 80° F, the circulating pump which moves this water through a water-to-air heat exchanger in the plenum of the heat pump shuts down and the heat pump carries the heating load. The system will be instrumented to allow the heat pump to operate with two options: (1) by itself entirely when water temperature is blow 95° F, and (2) the heat pump operating with water cooler than 95° F still circulating through the heat exchanger in the plenum, but no solar energy build-up of heat in the storage water due to lack of solar energy (from cloud cover).

3. Seasonal System Change-over - Seasonal change-over requires manual deactivation of the solar panel temperature sensing devices which activate the heat-transfer fluid pump, thus preventing daytime fluid circulation and subsequent heat build-up in storage. This occurs only when we do not want solar heat for domestic water preheat. The temperature sensing devices can be readjusted to permit a reversal of the system, thus circulating the heat-transfer fluid at night, which allows it to lose heat by sky radiation. Then daytime operation will utilize the forced-air system with the cooled water pumped through the liquid-to-air heat exchanger (same exchanger used in the heating operation) in the plenum when cooling is desired.

PROJECT PLANNING

The project's designer started research of solar information and technical reports early in 1971, before much attention was given to the virtues of alternative energy systems, in anticipation of its important possibilities and as preparation to design and implement a system for himself. In 1974 the project which the system was installed was designed, with construction starting about the same time the initial grant program was started, early in the summer of 1975.

Because of the early efforts towards developing the background for solar systems, the system was designed and performance calculations were made in the late months of 1974. In final preparation to the system design, the grantee attended a solar workshop in Vail, Colorado, sponsored by the University of Colorado with Jan F. Kreider, Ph.D. and Frank Kreith, Ph.D., and others who presented fundamental design philosophy and techniques for several types of systems. They later published the course workbook into a book, Solar Heating and Cooling, Engineering, Practical Design, and Economics. This workshop, along with an extensive study program, provided the basic training for the grantee to put the finishing design touches on the system. The system was designed to utilize the highest quality equipment possible within the limits of the original project budget of $14,245.00.

EQUIPMENT ACQUISITION

No major problems were encountered in acquiring equipment for construction of the system. Most hardware items were readily available from local suppliers or from solar equipment supply houses or manufacturers. The heat exchangers were adapted from components for other heating or cooling systems: the water-to-water coils are finned copper replacement coils for hot water boilers and the water-to-air coil is a hot deck coil for a package HVAC unit.

The major task in the design and final construction of the system was the control system because of a desire for little or no manual operation. Consequently, with two storage tanks, the control system has synchronized relays, differential thermostats and electric solenoid valves to to switch over between tanks for both heat storage and for the heating cycle. Refer to the photographs and diagrams of the control system. The following equipment list describes the equipment, its costs, its supplier or manufacturer, and a comparison to its initially budgeted cost. All equipment was purchased between July 1977 and January 1980.

Since many equipment purchases benefitted from wholesale purchase privileges and many items were adapted from other designed uses, a comparable cost for a similar system commercially installed would be considerably higher. Unit labor costs would undoubtedly be higher, but higher skilled workers would spend less time installing the different parts of the system, especially such parts as the plumbing and the controls. It seems, however, there is very little expertise available to design this type of system.

PROJECT EQUIPMENT

ITEM	BUDGET	SUPPLIER	COST
1.a. Solar Collectors - copper tube w/ alum. plate; dbl. glazed w/ low iron glass; black chrome selective coating in alum. frame. (8) 5' X 8' & (8) 3' X 8'	$7270.00	Solarmatic 1518 Dierker Drive Valrico, Fl 33594	$6597.12
b. Collector freight	-	Ryder & Burlington Northern	629.68
2. Collector mounting - 2X2's screwed to structure - and mounting.	150.00	Lumber yards	220.47
3. Storage Tanks - (2) 1050 gal (6' dia X 5'), galv., corrugated culverts w/ ends welded in place; supplied w/ fitting adaptors as specified.	1025.00	ARMCO Steel Corp. 415 Albert Street Billings, Mt 59102	1418.08
4. Storage Tank Insulation	150.00	Spiroglas 1000° from E. J. Bartell's Co. 1724 King Ave. W. Billings, Mt. 59102	166.23
5. Control Valves - (2) 1¼ brass solenoid valves & (4) 3/4" hydronic zone valves	275.00	Dayton 6X748 & 2E291 from W.W. Grainger 221 Moore Lane Billings, Mt. 59102	263.36
6. Water-to-Air Heat Exchanger - hot deck replacement coil	300.00	Carrier, Inc Climate Control, Inc E. 206 Augusta Ave. Spokane, Wash. 99207	74.00
7. Water-to-Water Heat Exchangers (4) finned copper boiler replacement coils.	200.00	Amtrol #108-7 coil Clapper Company 2102 Second Ave. N. Billings, Mt. 59101	271.32
8. Circulating Pumps a. Solar circuit - 1/6 hp, 120v, series HV		Bell & Gossett from Northwest Pipe Fittings, Inc.	114.36
b. Heating circuit - 1/12 hp, 120v, series 100	200.00	33 S. 8th St. W. Billings, Mt. 59102	78.88

PROJECT EQUIPMENT (cont)

	ITEM	BUDGET	SUPPLIER	COST
9.	Sensors, Relays, & Electrical Devices - (4) transformers,	$400.00	Dayton	23.34
	(5) relays,		from W.W. Grainger	50.32
	(1) low temp. limit switch,		221 Moore Lane Billings, MT. 59102	14.51
	(2) differential thermostats, DTT-70 & DTT-82,		Heliotrope Beneral 3733 Kenora Drive Spring Valley, CA 92077	106.03
	(1) high temp. limit,		Dayton	27.00
	(2) aquastats,		Honeywell L444B1011 Honeywell, Inc. 106 11th St. W. Billings, Mt. 59102	52.90
	(2) tank thermometers,		Palmer 3BC (0°-200°) from Scott Equip. Co. 123 N. 16th St. Billings, Mt. 59101	44.00
	misc. electrical material.			27.76
10.	Hot Water Preheat - 30 gal galv. steel pressure tank.	-	Midland Implement 425 Daniels Street Billings, MT 59102	50.00
11.	Piping, Fittings - copper pipe, brass valves, & 95/5 solder.	150.00	Northwest Pipe Fitting 33 S. 8th St. W. Billings, MT 59102	842.07
12.	Pipe Insulation - fiberglas blanket wrapped around piping.	-	Lumber yards	128.04
13.	Expansion Tank - w/ pressure relief valve.	80.00	Extrol 30 Northwest Pipe Fitting	83.18
14.	Antifreeze Solution & installation; storage tank water; pump rental to charge system.	-	Durex ethylene glycol mixed w/ distilled water	166.67
15.	Labor - in excess of 300 hrs.	800.00	Grantee	2400.00

TOTAL PROJECT COST TO DATE:

Without labor:	$11,449.32
With labor:	$13,849.32

SYSTEM INSTALLATION

Approximately 300 hours were used by the grantee to complete the project. Since this as an ezperimental project, it is anticipated that many more hours will be put in as modifications and adjustments are made.

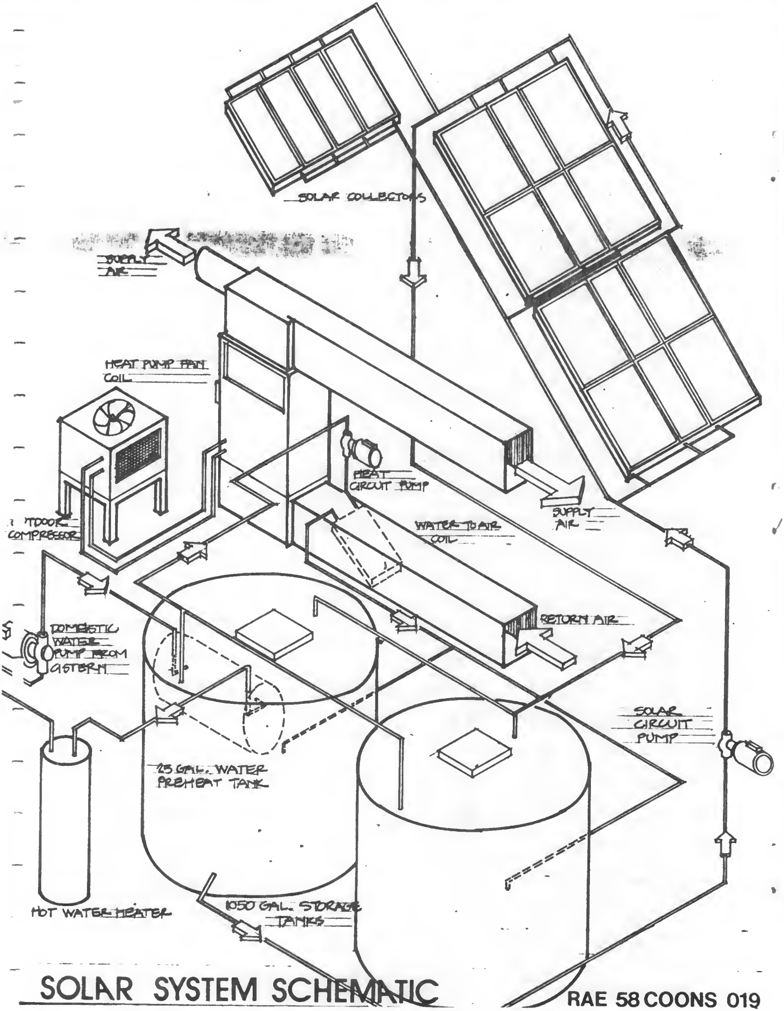
The major problems of installation were caused by the steep terrain of the site. Consequently, an unique method for installing the collectors was devised using a vehicle-mounted winch with the cable over the back side of the roof to pull the 200# and 300# collectors into position. Of course, the 60° angle of the roof presents a degree of danger to the installation crew for collectors, piping and pipe insulation, but this condition is not an unusual one for any such roof-mounted system in our region.

The installation crew was a crew of eight friends, working for the joy of good fellowship, a sunny day, and lots of beer and hamburgers. Collector installation took two days after the support framing of 2X2's was installed by the grantee. A moving scaffold, several safety ropes, Jumar climbers, and slings were used throughout the framing and collector, piping, and insulation installation processes. Although many hours were needed to finally complete the exterior work, most of it went smoothly and without accident.

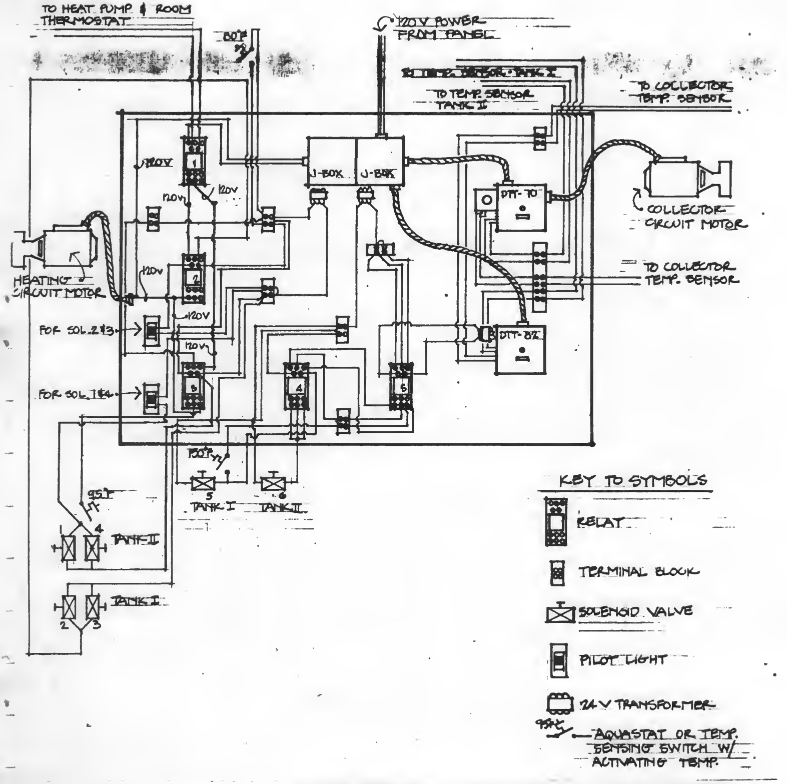
The progress of the project was affected by several factors. First, since the grant was awarede while the house was under construction and most of its construction was done by the grantee, its completion took priority over the solar system. Second, though the winter of 1976-77 was relatively mild when much work could have been accomplished, the following two winters dealt severe conditions for outside work and little work could be done on the system. The following time schedule shows the dates of major phases of the system construction.

CONSTRUCTION SCHEDULE

Grant Request submitted:	29 April 1976
Grant awarded:	3 November 1976
Solar collectors ordered:	11 May 1977
Collectors delivered to site:	20 August 1977
Collector installation started:	17 October 1977
Collector installation completed:	31 October 1977
Storage tanks ordered:	25 October 1977
Collector piping started:	12 November 1977
Water-to-air exchanger received:	15 December 1977
Water-to-water exchangers received:	27 December 1977
Storage Tanks delivered:	4 June 1978
Tanks moved into basement:	1 July 1978
Piping completed:	January 1979
Control system designed:	11 February 1979
Control system construction started:	20 February 1979
Control system completed:	May 1979
Pipe insulation started:	September 1979
Hot water preheat mounted:	November 1979
Pipe insulation finished:	15 December 1979
System filled with antifreeze solution:	30 December 1979
System started:	1 January 1980
System troubleshooting:	January - February 1980
Final Grant Report:	March 1980



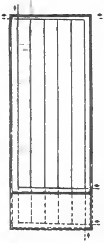
SOLAR SYSTEM SCHEMATIC



CONTROL BOARD DIAGRAM

RAE 58-COONS-019

STANDARD SOLARMATIC™ COLLECTORS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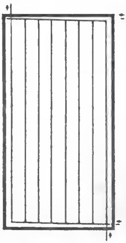
Model 3492-½-6-M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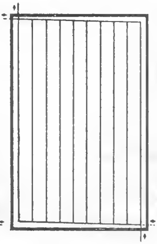
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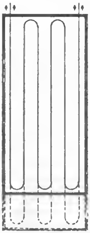
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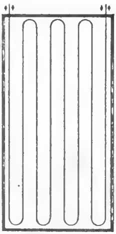
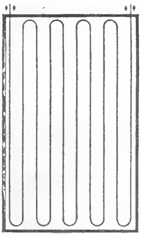
Model 3492-½-6-S


Model 4692-½-6-S


Model 5892-½-6-S

Note: Vertical Orientations Shown; Serpentine Collectors May Be Mounted Horizontally with Inlet at Bottom and Outlet at Top

SOLARMATIC™ SOLAR COLLECTOR INFORMATION

STANDARD INCLUSIONS, ALL SIZES

.080" (2mm) Wall Extruded Anodized Aluminum Case
Reflective Insulation Edges and Bottom
Closed Pore Glass Setment—For Single or Dual Glass
Dual Glass is of Sealed Insulating Type with HiTemp Sealant
Dielectric Through-Case Tube Grommets
Siliconized Glass-to-Case Sealant
Sol-Ective Collector Bed Finish, Carbon-Oxides-Silicone
Sheet Aluminum Bottom Cover
1/2" ID (12.7mm) Type "L" Copper 6" (15.24cm) on Centers—Serpentine Pattern
Single 3/16" (4.76mm) Tempered Glass

OPTIONS, SOME AT EXTRA COST

Manifolded Grid Layout—Various Tube Wall Thicknesses
Special Collector Sizes Necessitating Special Glass Sizes
1/8" (3.18mm) Tempered Glass—Model 3476 Only
1/8"(3.18mm) Dual Glass—Model 3476 Only
3/16" (4.76mm) Dual Glazing—All Models
Semi-Selective Collector Bed Finishes
Fully Selective Collector Bed Finishes—Black Chrome
Solenoid Valves, Motorized Valves, Electronic Controllers, Pumps and Motors—Various Current Characteristics
Roof or Ground Mounting Brackets

SOME ACTUAL SIZES

Model	3476		3492		4692		5892	
Entire Panel	37"x79"	20.30SF	37"x95"	24.41SF	49"x95"	32.33SF	61"x95"	40.24SF
Metric Equiv.	94cm x 201cm	1.886SM	94cm x 241.3cm	2.268SM	124.5cm x 241.3cm	3.003SM	154.9cm x 241.3cm	3.738SM
Glass Size	34"x76"	17.94SF	34"x92"	21.72SF	46"x92"	29.39SF	58"x92"	37.06SF
Metric Equiv.	86.4cm x 193cm	1.666SM	86.4cm x 233.7cm	2.018SM	116.8cm x 233.7cm	2.730SM	147.3cm x 233.7cm	3.443SM
Aperture Size	33"x75"	17.19SF	33"x91"	20.85SF	45"x91"	28.44SF	61"x91"	36.02SF
Metric Equiv.	35.5cm x 190.5cm	1.597SM	35.5cm x 231.1cm	1.937SM	114.3cm x 231.1cm	2.642SM	154.9cm x 231.1cm	3.346SM

SOLARMATIC DIVISION
OEM PRODUCTS, INC.

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SYSTEM TESTING AND MODIFICATION

The piping system was tested with an air compressor for leaks and subsequently repaired. An assortment of valves have been installed to drain, fill, bleed, and monitor the flow in the system.

The electrical control system was tested by simulating operational situations to verify the temperatures which activated pumps, valves, and fans. Only three minor modifications of the initial design were made: a larger transformer was substituted, one relay was removed because it was not necessary, and two pilot lights were added to show when the heating system pump operated and when a set of solenoid valves opened.

A future system modification will be to increase the amount of insulation around the storage tanks because there is too much heat loss from them.

SYSTEM PERFORMANCE

The period since system startup has been interspersed with system breakdowns, and a lack of sunshine. An additional complication attributed to the system during this period developed when the grantee fell from the roof of the house while repairing an aspect of the system, breaking his wrist. Surgery was required, consequently delaying by several weeks some modifications, which although minor, were necessary for jull system operation.

However, during one period of operation just after initial startup in January, over a period of 7½ hours of collection of solar energy under fully clear skies, 1050 gallons of storage water heated up from 64°F to 104°F, which is 351,920 BTU's or 46,923 BTUH to storage. From the calculations originally made in the grant application to determine system performance, there would be approximately 4006 BTU/SF available at the collectors for a clear day. Consequently, with 450 SF of collector aperature, there was available 1,804,000 BTU to the collectors for these 7½ hours. Comparing this to the amount of energy actually transferrred to the storage water, the system efficiency would appear to be 20 percent, without consideration of haze effects, wind, ambient temperature, etc. If we use the conservative figure of abailable solar presented in the grant application for January, there was 552,904 BTU to the collectors for the 7½ hours. This would give a collection system efficiency of 64 percent. We would guess the real efficiency lies between these two. Until na exact measure of abailable sun is taken at the site, we can only predict probable efficiencies because the actual available solar is such a variable figure, only to be accurately determined by on-site measurements.

During the two months of system operation several system modifications have caused minor operational changes and some have caused system malfunctions, resulting in a great amount of time spent troubleshooting to determine the cause of the breakdowns. On two occasions when the sun was shining but the circulation system malfunctioned, th e system built up enough pressure to turn the heating solution to steam and blow open the pressure relief valve, releasing antifreeze solution, and introducing air into the piping. As a result, the system had to be recharged. One broken pipe during this period also caused a major antifreeze leak and required recharging. All in all this period has been rather exasperating, but the system should now be relatively trouble-free.

Because of the many periods of system downtime, the residential heating portion has not worked, due to low storage temperature. However, this aspect should now be corrected. Usable water temperature is anything above 80°F to 95°F being used as supplemental heat to the heat pump, and temperatures above 95°F as warm enough to carry the heat loss load exclusively.

Under simulated operation the system works as designed, with the solar system operating first when the room thermostat calls for heat if storage water temperature is greater than 95°F, then in tandem with the heat pump in the temperature range of 80°F to 95°F. Thereafter, the heat pump carries the load. The control system for the heat pump was modified by the addition of an outdoor thermostat to repace the second stage of the room thermostat, which was pushed back to operate the heat pump. The first stage of the thermostat, which originally operated the heat pump, now activates the solar heat circulation pump and the furnace fan if the water temperature is above 80°F.

ECONOMIC EVALUATION

Using the energy collected in storage and then converting that to a value equivalent to electricity, the cost savings contributed by the system is determined. Tabulated here are the energy quantities used in the previous winters of occupancy of the house.

Total Energy Used - September through February

1977-78: 34,120 KWH

1978-79: 31,920 KWH

1979-80: 17,840 KWH

Household Uses: 480 KWH/mo X 6 mos = 2880 KWH

Heating Energy Used:

1977-78: 31,240 KWH

1978-79: 29,040 KWH

1979-80:* 14,960 KWH

TOTAL: 75,240 KWH

AVERAGE: 25,080 KWH

*The great difference tetween this season and the previous two seasons is largely due to a much milder winter as well as some energy conservation measures.

Based on available sun for Billings according to the compiled and calculated weather data in the grant application, the system should collect heat for the winter periods for which we have tabulated household energy usage as shown below.

January: 10.28×10^6 BTU

February: 9.78×10^6 BTU

September: 13.61×10^6 BTU

October: 13.88×10^6 BTU

November: 11.42×10^6 BTU

December: 8.78×10^6 BTU

TOTAL FOR PERIOD: 67.75×10^6 BTU

PAYBACK PERIOD CALCULATION

1. At a system collection efficiency of 20%, the system would produce energy savings of $97.66/yr, using

Montana Power's current rates of \$.0246/KWH. This then gives a payback period of 117 years at the actual costs of the system (not including any value for labor.)

2. At system collection efficiency of 64%, the system would produce energy savings of \$312.53/yr. at the same power rates. This payback period is 36 years at the actual costs of the system.

If we use the solar data tabulated in The Montana Solar Data Manual for Billings (it needs a longer period of data collection to be really reliable), the amounts of solar energy available would be as follows:

January:	12.58 X 10^6 BTU
February:	16.03 X 10^6 BTU
September:	22.07 X 10^6 BTU
October:	16.33 X 10^6 BTU
November:	13.22 X 10^6 BTU
December:	12.93 X 10^6 BTU
TOTAL FOR PERIOD:	93.16 X 10^6 BTU

1. Using this energy, at a system collection efficiency of 20%, the system would produce energy savings of \$134.29/yr. at current power rates. The payback period is 85 years at the actual costs of the system.

2. At system collection efficiency of 64%, the system would produce energy savings of 429.74/yr. at current power rates. This payback period is 26 years at the actual costs of the system.

As can be seen from the above examples much more accurate solar data is necessary to determine real payback periods. This will be an on-going part of the monitoring process of this system. Another point about these efficiency calculations is that they are made from actual performance observations made only in January. Greater values should be the case for other months of the year as the solar intensity is greater.

CONCLUSION

It is extremely difficult to give a valid evaluation of the system as shown by the economic evaluation, until further operational data can be compiled. Therefore, to comment extensively about its feasibility could be premature, but we will put forth our views with current observations and experience. In a strictly objective evaluation, we would suspect that economists and accountants would say the project is not feasible and we must agree. One wonders how much energy savings would be generated if $11,449.32 had been invested in increased building insulations and greater passive solar techniques, although many passive principles were employed in the house design.

When additional data is in and the power rates continue to increase, the project will show a shorter payback period. Simply by doubling the power rates, a more realistic payback period develops. From the standpoint of the original objectives of this project, it is still a valid demonstration of this type of an alternative energy system. Its primary value is its potential use for retrofitting existing buildings in order to reduce non-renewable energy consumption, rather than built into new construction. In new construction the amount of money spent to design and install this system, or any active solar system for that matter, would be much better spent on passive energy measures to create pleasant, yet functional, complete energy-conserving machines for living and working. Domestic hot water heating, which can use the solar year-round is more economically feasible, especially with large families or businesses with high water demands.

One of the major goals of this system in the design of it was to make it as trouble-free and as automatic as possible so it could work without concern or thought from the building occupants. To this extent the control system has a relatively complex nature and could present problems in finding troublespots when there is a breakdown in it. However, to date that system has presented no problems. Accomplishing this could probably be realized with less potential for troubles by using commercially available control systems.

In the initial startup and shakedown period a better method of system charging and drain down should be incorporated because this had to be done several times in the first two months of operation. In this case, this would require an antifreeze holding tank of 35 gallons and a medium-head pump. Other modifications intended fro the system which should have been originally installed are (1) a flow indicator and meter in the piping to help determine full charge and operation flow rates so optimum rates could be set; (2) a flow switch which would shut down the circulation pump should flow stop or be reduced below the minimum required for the pump to operate; (3) as mentioned earlier more storage tank insulation and pipe insulation protective covering; (4) isolation valves on each side of the pumps so they could be removed without draining the system; (5) and for monitoring purposes, remote temperature sensors with readouts for collectors, heat collecting fluid, storage water, duct air temperatures,(both return air and supply air), and elapsed time indicators to indicate hours of collection time and heating time.

From a standpoint of other shortcomings of the project, the only others of major consequence have to do with finances and time required to build the project. The financial aspect is more in criticism of the grant program, and in a way so is the time problem. They are both related.

Although a few pieces of equipment were overlooked at the time of the grant request (specifically hot water preheat tank, a great amount of piping, fittings, and valves, the antifreeze solution and the pipe insulation), the overall estimate of system costs was fairly accurate. All in all, the system has not been drastically modified since the grant request, although some minor adjustments have been made. This accuracy reflects the grantee's resolve to adapt equipment and take advantage of professional discounts, rather than the actual costs of a similar system which would be commercially installed where profit, labor and overhead would also be added to equipment costs.

Realizing the original intention of the grant program, i.e., to be somewhat of a self-help program to implement alternative energy projects, this project has been accomplished to that extent. It has, however, been delayed considerably because of the grantee's priorities for career development and some time for a personal life, preempting time necessary to work on the sytem. And finally, almost every aspect of the work demanded much more time to accomplish than estimated. Our final evaluation is that if it had been funded to the full amount of the original request, the system would have been completed much earlier, and probably more professionally when skilled labor would have been employed to install equipment and check out the system. A review of the system cost tabulation shows that the original request would have been only 3% over the costs of the system, although real labor costs of skilled craftsmen would probably have been higher.

MONITORING

The system will be monitored to see how much solar energy is stored, its rate of collection, and how much heat is used for household conditioning. The method of monitoring will be the recording of storage temperatures, time of operation of the circulation pumps, conversions of temperatures to heat, and the maintenance of a weather log.

To facilitate this monitoring process, several pieces of equipment should be installed. They are remote reading thermometers, elapsed time recorders, and an anemometer for wind speed recording. Before they are installed, simple manual and visual techniques will be employed to record data and compute the effects. We would attempt to distribute this imformation annually to the state.

PUBLIC AVAILABILITY

Since operation has not been realistically long enough to compile good performance data, the best time for public review would be most beneficial after the system has worked through at least part of a heating season. It seems now that that would be at the earliest the fall of 1980, giving spring and fall 1980 for heating season operation. This grantee has always intended to have a public openhouse at the project when it is completely operational and will probably schedule such an event in the fall of 1980.

There have been approximately 150 visitors to the residence to see it and the solar system. A meeting is tentatively scheduled in the spring of 1980 for the Billings Architectural Association at the house to discuss other energy projects in our region/

In 1976 in the cover letter of the grant request it was stated that "...government incentives are probably the best way alternative energy systems will be implemented now." And now in 1980, we continue to advocate this leadership role of bovernment to present incentives and offer programs which will arouse the private sector into implementing more use of alternative renewable energy sources, and most specifically solar because it is probably the least technically demanding and most economically feasible resource which can be utilized by the individual. But more must be done! More programs should be funded and encouraged by institutions and governments which are in positions of leadership and trendsetting roles so that the private sector follows. And programs and methods which are economucally viable should be encouraged over those which are of questionable economic and technical feasibility.

Conservation measures of better insulation and weather protection and extensive utilization of simple passive solar techniques are viable means which can be incorporated into almost all ordinary building. Greater encouragement of the use of these measures would be a giant step forward to reduce demands on consumption of existing energy sources. To the huge quantity of existing buildings, retrofitting of both active solar systems, passive measures, and better insulation should be encouraged, if not mandated.

The grant program authorized under Senate Bill #86 has done a lot towards encouraging this private sector involvement, but the program has been entirely too low-keyed in telling the public at large that the program is available. The number of applications for grants should be far in excess of the 38 which were received for the 1979 grant period, and the number of projects funded should be increased dramatically, especially if grant if grant funding is doubled. obviously some funds must be utilized to administer the program, but there should be a very specific program within the administration to disseminate information to the public, advertise heavily of each grant period deadline, and to offer regional public workshops for prospective applicants to counsel and encourage them to submit grants for the program.

Specifically in regards to the affectiveness fo the program, this grant is a good example of the problems of project completion when the grantee must contribute his own labor, and sometimes materials to finally achieve completion. When only evenings and weekend time is available, projects are necessarily going to be prolonged.

Very thorough evaluation of the cost estimates submitted for the projects and of the proposed time schedule should be completed by a technically competent staff or professional at the time of submission of the grant requests, and help and counsel provided to those awarded where there are minor discrepancies and oversights. This would facilitate completion of projects and give the public more information.

In general, however, the program has many more merits than shortcomings and has helped produce many projects which would not have otherwise been possible. Let's see more!

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